



**IRRESISTIBLE  
MATERIALS**

**14 nm halfpitch @ < 20 mJ/cm<sup>2</sup>**

## IRRESISTIBLE MATERIALS Q4 '14 Molecular Resist Update



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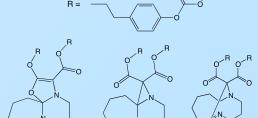
<sup>d</sup>Nanoscale Physics Research Laboratory, The University of Birmingham, B15 2TT Birmingham, UK

<sup>e</sup>Laboratory for Micro and Nanotechnology Paul Scherrer Institute, 5232 Villigen, Switzerland

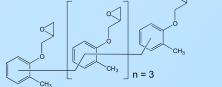
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### xMT System

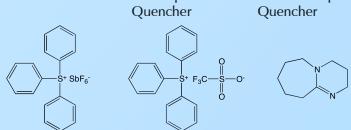
xMT Molecular resin



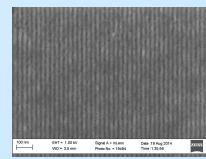
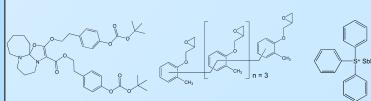
Crosslinker



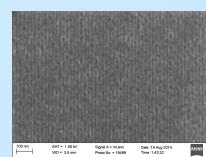
PAG



### IM-xMT-C2A 1:2:1 - PSI Exposures



CD: 13.8 nm  
Dose: 25 mJ/cm<sup>2</sup>\*  
LER: 6.6 nm

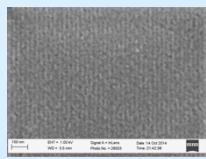
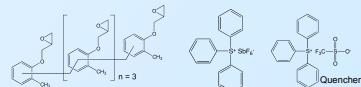


CD: N/A (hp 11 nm)  
Dose: 44 mJ/cm<sup>2</sup>\*  
LER: N/A

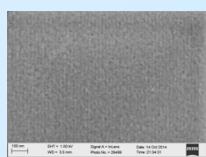
\*dose estimate

### Epoxy only - PSI Exposures

2:1 CL08-01 : TPS SbF<sub>6</sub> PAG + 5% Quencher



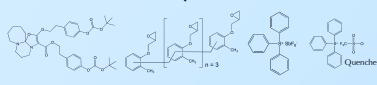
14 nm hp  
Unresolved any dose



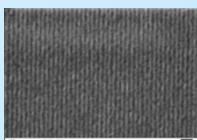
11 nm hp:  
Unresolved any dose

### High Speed xMT Formulation

0.2:2:1 xMT-C2A : CL08-01 : TPS SbF<sub>6</sub> PAG + 5% Quencher



14 nm hp:  
Dose to wafer\*: 6 – 12 mJ/cm<sup>2</sup>



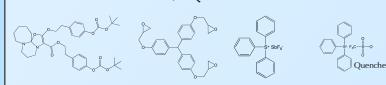
11 nm hp:  
Dose not yet calculated



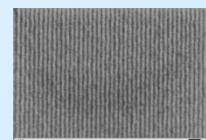
\*dose estimate

### Alternate Crosslinker

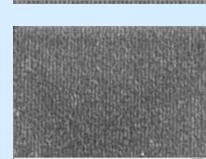
0.2:2:1 xMT-C2A : CL06-14 : TPS SbF<sub>6</sub> PAG + 5% Quencher



14 nm hp:  
Dose to wafer\*: 9 – 18 mJ/cm<sup>2</sup>



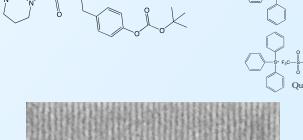
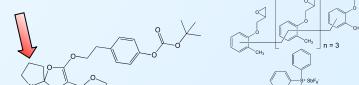
11 nm hp:  
Dose not yet calculated



\*dose estimate

### Alternate xMT

0.2:2:1 xMT4 : CL06-14 : TPS SbF<sub>6</sub> PAG + 5% Quencher

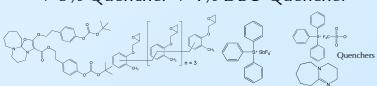


14 nm hp: Dose to wafer\*: 9 – 18 mJ/cm<sup>2</sup>

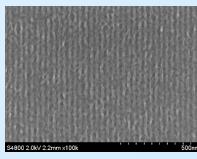
\*dose estimate

### MET Exposures

0.2:2:1 xMT3 : CL08-01 : TPS SbF<sub>6</sub> PAG + 5% Quencher + 1% DBU Quencher

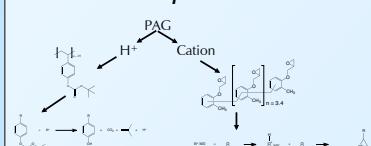


18 nm hp at 23 mJ/cm<sup>2</sup>



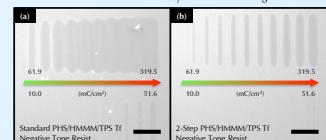
35 nm contacts at 33 mJ/cm<sup>2</sup>

### Two Step Mechanism



The 2-step mechanism requires both a deprotection and a crosslinking step. In areas of high acid this does not affect sensitivity. At the edges of features it increases chemical gradient due to catalytic inefficiencies – effectively quenching without affecting sensitivity.

The effect is shown here in a trilate based system chosen for high diffusion levels:



xMT incorporates a novel molecular resist with the new 'two step' chemically amplified mechanism to achieve a combination of high speed and resolution.

### Acknowledgements

investing  
in your  
future  
European Regional Development Fund  
Bridging the Gap

Advantage  
West Midlands  
[www.advantagewm.co.uk](http://www.advantagewm.co.uk)

Engineering and Physical Sciences  
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materials that power our world  
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